PROGRAM REVIEW 1986 - 87

NORTHERN FORESTRY CENTRE

Government of Canada
Canadian Forestry Service

Gouvernement du Canada
Service canadien des forêts

Canada

88-02011/

PROGRAM REVIEW 1986-87

NORTHERN FORESTRY CENTRE
CANADIAN FORESTRY SERVICE
1987

©Minister of Supply and Services Canada 1987
Catalogue No. Fo41-11/1987E
ISBN 0-662-15648-X
ISSN 0714-1920

This publication is available at no charge from:

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The Canadian Forestry Service

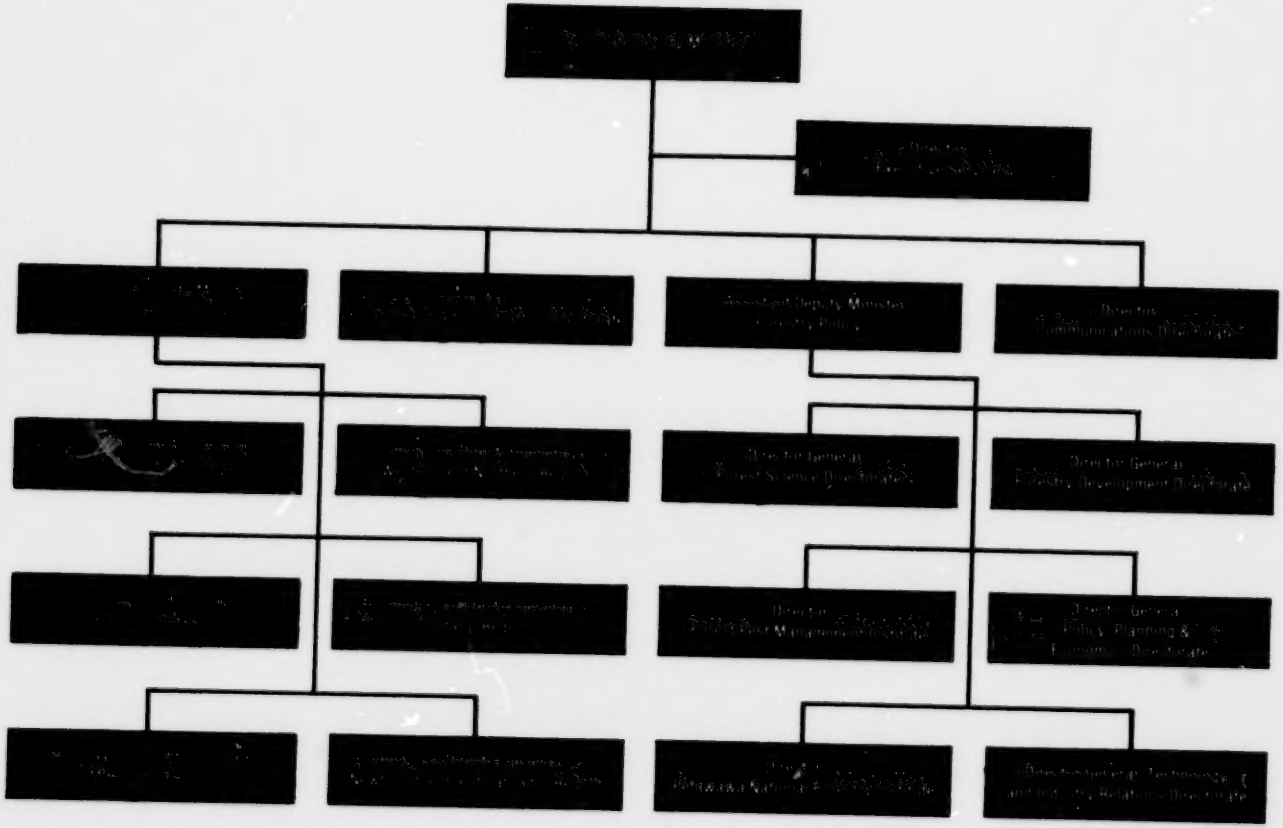
The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry and has been designated as the government's lead agency for forestry matters. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social, and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. coordination of federal policies, for the promotion of better resource management and forest industry development;
2. provision of scientific and technological leadership in forestry through research and development;
3. provision and analysis of national and international statistics and information as a basis for policy formulation;
4. development and certification of codes and standards for wood product performance;
5. protection of Canada's forests from foreign pests;
6. fostering the potential use of the forest resource for energy;
7. contributing to the environmental objectives of the Government of Canada.

Canadian Forestry Service programs are coordinated with those of other forestry agencies through a variety of mechanisms, including the Canadian Council of Forestry Ministers, the Forest Sector Strategy Committee, management committees for Federal-Provincial Forestry Development programs, national and regional Research Advisory Committees, and various technical committees for specific program areas.

The Canadian Forestry Service is comprised of a headquarters unit, six forestry centers, and two national institutes. The forestry centers are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments and other clients. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope.



Le service canadien des forêts

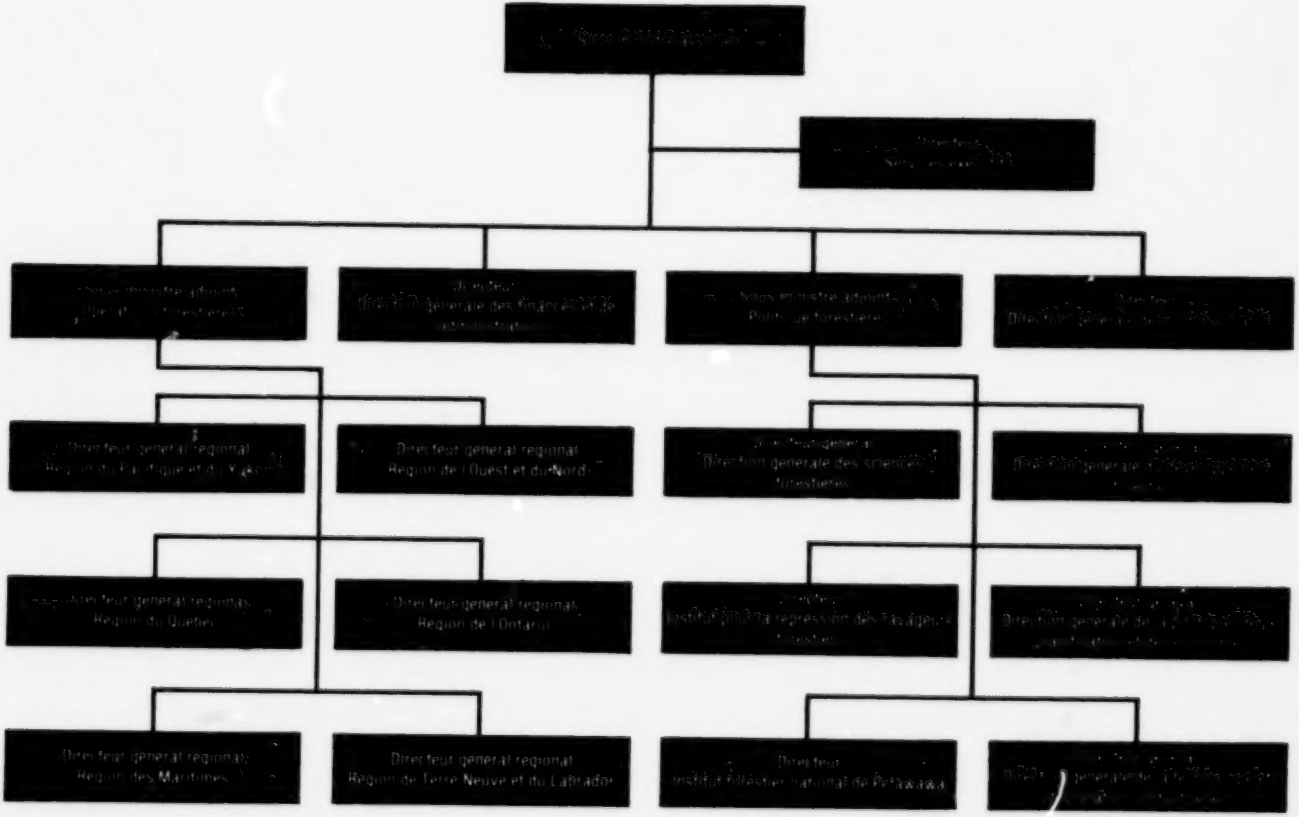
Le Service canadien des forêts (SCF) réunit la majorité des spécialistes fédéraux en foresterie; il a été désigné comme l'organisme officiel du gouvernement responsable du secteur forestier. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF:

1. coordonner les politiques fédérales afin de favoriser l'amélioration de la gestion des ressources et l'expansion de l'industrie forestière;
2. fournir une orientation scientifique et technologique dans le domaine de la foresterie, par la recherche et le développement;
3. fournir et analyser les statistiques et l'information nationales et internationales qui serviront à établir les politiques;
4. mettre au point et homologuer des codes et des normes en matière de rendement des produits du bois;
5. protéger les forêts canadiennes en luttant contre les ravageurs étrangers;
6. parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie;
7. adhérer aux objectifs environnementaux du gouvernement fédéral.

Les programmes du SCF sont menés de concert avec ceux d'autres organismes forestiers par l'entremise de divers méchanismes dont le Conseil canadien des ministres des Forêts, le Comité de la stratégie forestière, les comités de gestion des programmes fédéraux-provinciaux de développement forestier, les comités nationaux et régionaux consultatifs sur la recherche, de même que divers comités techniques axés sur des domaines de programmes spécifiques.

Le Service canadien des forêts comprend une administration centrale, six centres forestiers et deux instituts nationaux. Les centres forestiers doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyers des programmes d'envergure nationale.



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Director's Report

During the past year, the mission and goals of the Canadian Forestry Service (CFS) continued to evolve in response to new issues, changes in the role and responsibility of the Service, and perceptions about the development, coordination, and implementation of federal policies and programs. In the Western and Northern Region of the CFS (Alberta, Saskatchewan, Manitoba, and Northwest Territories), priority attention was placed on the development of a strategic initiatives paper to provide program direction into the 1990s. The future orientation of forest research and regional development programs will be guided by the strategic issues identified in the paper, with specific research and development initiatives identified and implemented within the service-wide integrated planning process now in place. Recommendations provided by the Senior Regional Advisory Committee (SRAC) and similar regional and national mechanisms are considered as important inputs to this process.

Significant shifts in emphasis have been or will be implemented in response to many issues and work priorities, including the following:

- There is a need to maintain small district offices in Manitoba and Saskatchewan to enable the CFS to effectively fulfill its mandate in these two provinces.
- There is a need to strengthen integrated research and innovation in support of management and protection of forest plantations.
- Environmental considerations will continue to form an important component of the Northern Forestry Centre's (NoFC) research on forest management and protection.
- A reasonable share of NoFC's scientific expertise must have the freedom to pursue longer term and in-depth research not linked to immediate practical payoff.
- Increasingly, routine site-specific operational programs will be replaced by research initiatives to support a systems approach to forest management.
- There will be a strengthening of the knowledge base, and methodology and standards for forestry statistics and economic analysis of the forestry sector;
- Desirable technology transfer objectives will be considered as an integral part of research management, rather than as an independent ad hoc activity;
- Advisory committee structures and mechanisms will continue to be streamlined to optimize the identification of research needs.

During the year, the Centre lost two positions as part of the federal government's downsizing program. In addition, the CFS' Human Resources Program, including the CFS Forestry Scholar Program and the Program of Research by Universities in Forestry (PRUF), was terminated. For the present, the three federal-provincial forestry agreements in the prairie provinces provide significant incremental funding support of forest research. Particularly noteworthy is the $10 million forest products research and development program under the Canada-Alberta Forest Resource Development Agreement. The implementation of this innovative program has coincided with a 300% increase in hardwood utilization during the past several years. This product and market-oriented program provides a new dimension to federal-provincial efforts to diversify the forest industry and to develop new value-added products.

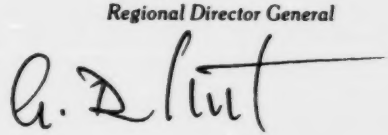
The 1986–87 operating year was marked by a number of significant events and achievements. Two major publications, *Forest tree diseases of the prairie provinces*, by Dr. Yasu Hiratsuka, and *Field guide to forest ecosystems of west-central Alberta*, by Drs. Ian Corns and Rick Annas, were published and widely distributed. A highly successful Geographic Information Systems (GIS) Workshop, organized by the Canadian Forestry Service in cooperation with the provinces of Manitoba, Saskatchewan, and Alberta and sponsored by the respective federal-provincial forestry agreements, was held in Winnipeg in early 1987. The over 250 participants agreed that geographic information systems are rapidly assuming a key role in linking multiple land-use activities with specific forest management requirements.

Several research studies reached the pay-off stage. Based on work at the Northern Forestry Centre over the past 15 years, the first fully operational large-scale photo (LSP) sampling system was produced for use in Yukon Territory. An innovative slide-rule forest fire growth calculator was developed by a NoFC fire researcher and received immediate application across Canada. The WRENSS computer-based procedure for predicting effects of forest harvesting activities on annual streamflow was adopted for use in Alberta. A regional Growth and Yield Cooperative was formally established to provide coordination and focus to a common permanent sample plot (PSP) computerized data base and research in support of forest productivity prediction. A new study entitled Boreal Forest Risk Factor Modeling was initiated to determine the impact of forest fires and large-scale insect and disease infestations on the present and future forest yields.

In the area of communication and forestry awareness, CFS staff in the prairie provinces participated in numerous events (fairs, exhibits, etc.) and made direct contact with over 90,000 Canadians. An impressive mobile trailer exhibit, *Alberta's Managed Forests*, sponsored by the Canada-Alberta Forest Resource Development Agreement, was launched and visited by about 30,000 individuals. The Centre published the inaugural issue of a quarterly newsletter *TimberLines*. In total, more than 75 scientific and technical publications were produced.

We welcome Ray Fautley as the Manager of the district office in Prince Albert, Saskatchewan. Ray takes over from Jim Farrell, who accepted a position with the Great Lakes Forestry Centre in Sault Ste. Marie, Ontario.

A.D. Kiil
Regional Director General



Forest Protection Research

NOR-7

Environmental effects of toxic substances and vegetation management

Objectives: To determine the impact of pollutants on native soils and forest ecology; to provide federal, provincial, and industrial resource managers with advice on the assessment of air pollution impact on forest soils and vegetation; to determine the fate of herbicides and herbicide residues used in forestry applications in native soils and the impact of herbicides on native plant communities and key species; to determine the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological and chemical control of tree nutrient requirements and uptake; to assess the impacts of industrial development on the terrestrial environment and recommend measures for mitigating the damaging impacts of the proposed developments; to provide analytical services to NoFC staff as required by ongoing research studies and develop new analytical techniques as required.

Achievements: Descriptive studies on the pattern and impact of pollutant deposition in several industrially developed areas have been completed. Both laboratory and field studies on soils and plants have resulted in biomonitoring techniques. Studies have been carried out on the interaction of environmental and biotic factors that influence the impact of a pollutant on forest species. Studies have also been carried out on elemental S deposition, nutrient availability, and on sulfur dioxide (SO_2) generation from sour gas plants and its effect on forest soils and vegetation. Effects of SO_2 exposure on photosynthesis in pine and aspen cuttings from the Athabasca Oil Sands and on the lichen *Evernia mesomorpha* have been studied. Several articles on the influence of pollutant deposition or uptake on plant communities and soil chemistry and biology have been published.

A new study on the environmental impacts of forest vegetation management techniques, including herbicides and their residues, was initiated in 1985–86 and a work plan for interdisciplinary research on the study was prepared and implemented. The field plots were set up near Grande Prairie in 1986. The plots were sampled for pretreatment evaluation and then treated with Pronone. Mechanical treatments and planting of crop seedlings will be completed in 1987.

Investigations of the distribution of radionuclides around uranium mining and milling operations in the Uranium City area were carried out. A paper was published on fission track mapping of black spruce.

An active role was played in preparing guidelines for ARNEWS (Acid Rain National Early Warning System) plot selection, sample collection and preparation, and chemical analysis of ARNEWS samples.

In addition, all NoFC studies were reviewed for environmental implications, and work was undertaken on the effects of herbicides on selected mycorrhizal species.

1987–88 objectives: To publish journal articles on the influence of pollutant deposition or uptake on plant communities including lichens, on soil chemistry and biology, and on vascular plant physiology; to continue to measure the rate and effect of pollutant deposition on soil chemistry and tree response; to reexamine biomonitoring plots around sour gas plants; to sample the plots in the bench-mark study on the impact of vegetation management methods, including herbicides; to operate and maintain a herbicide residue analytical laboratory; to publish results of experiments on the effects of hexazinone and Roundup on in vitro growth of mycorrhyzae; to study the fate of herbicides and herbicide residues in forest soils and vegetation and the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological and chemical control of tree nutrient requirements and uptake; to provide analytical services to NoFC as required by ongoing research studies.

Studies:

Assessment of air pollution impact on forest systems and of industrial development in natural areas

Impact and residue chemistry of forestry herbicides

Environmental impact of silvicultural practices on soil–plant nutrient dynamics, tree growth, and physiology

Analytical services laboratory

Project leader:
Dr. S.S. Sidhu

Professionals:
J.C.Y. Feng
Y.P. Kalra
Dr. D.G. Maynard

Technicians:
M.D. Fairbarns
C. Feng
(From June 1986)
L.J. Milward
R.G. Radford
J.I. Ridgway
(Retired May 1986)
J. Shuya

NOR-11

Forest insect and disease surveys and management systems

Objectives: To gather new knowledge of major forest insects and diseases for the purpose of understanding and minimizing damage attributable to these organisms; to contribute to a national overview of important forest pests and to the ARNEWS (Acid Rain National Early Warning System) program; to detect acid rain damage to the forest vegetation; to conduct research on the biology and damage impact of specific insects and diseases; to develop or modify appraisal methods for assessment of losses caused by forest pests; to maintain and upgrade reference collections of insect and disease specimens; to conduct quarantine-related surveys.

Achievements: Infestations of important pests were monitored, mapped, and assessed for damage impact, and the results were summarized in an Information Report. Areas of moderate-to-severe defoliation were caused by the spruce budworm, mountain pine beetle (MPB), spruce beetle, forest tent caterpillar, and jack pine budworm.

Pest extension services were provided by processing about 2000 inquiries and by setting up information booths on tree pests on several occasions. Information on tree pests was disseminated to various agencies and the public via pest leaflets, publications, slide presentations, and workshops. Several special surveys and collections were made for new or introduced pests of nurseries and for pinewood nematode. Ten ARNEWS plots were remonitored, and two new plots were established. Functional guidance was provided to insect and disease survey staff in Manitoba under the Canada-Manitoba Forest Renewal Agreement, and insect and disease projects were continued under the Canada-Alberta and Canada-Saskatchewan forest resource development agreements.

A handbook entitled *Forest tree diseases of the prairie provinces* was published; it describes major forest tree diseases of the Canadian prairie provinces in terms of their cause, distribution and hosts, symptoms and signs, disease cycle, damage, and control.

Field studies were continued in cooperation with the University of Calgary, B.C. Ministry of Forests, and Alberta Forest Service (AFS) on the application of pheromones (behavior-modifying chemicals) for detection, monitoring, and control of MPB, spruce beetle, and spruce budworm. Input was provided to the MPB Interagency Committee and on the Canada-U.S. Action Plan on MPB-lodgepole pine management, including the field testing of MPB hazard rating systems.

Damage impact studies on infestations of jack pine budworm in Saskatchewan and Manitoba, MPB in the Rocky Mountain national parks, spruce budworm in Manitoba, and dwarf mistletoe in Saskatchewan were continued for ongoing estimation of losses. Field and laboratory studies were designed and initiated to provide the information necessary in developing a pest management system for jack pine budworm in Saskatchewan and Manitoba.

Cooperative studies with the University of Alberta and AFS were conducted toward development of native pines resistant to western gall rust. The first draft of an Information Report entitled *Impact of pine stem rusts of hard pines in Alberta and the Northwest Territories: 10-year plot study*, has been completed. Studies on Armillaria root rot were continued, and results were presented at scientific meetings.

1987–88 objectives: To survey, map, and report on major pest infestations such as the mountain pine beetle, spruce beetle, forest tent caterpillar, and spruce and jack pine budworms; to monitor other noteworthy forest pests; to provide diagnostic and advisory services; to modify and develop appraisal methods for assessment of losses caused by major forest pests; to conduct research on selected forest tree diseases, especially forest tree rusts; to maintain an acid rain national early warning system on damage to the forest; to initiate a new study on economically important forest tree diseases such as Armillaria root rot, western gall rust, aspen decay, and selected seed, cone, nursery, and plantation diseases, emphasizing practical, client-oriented field activities designed to fulfil the operational needs of forest managers.

Studies

Forest insect and disease survey
Sawfly systematics
Biological asessment of insects injurious to trees and shrubs
Forest insects: diagnostic and taxonomic services
Damage appraisal of major forest pests
Forest tree rusts of western North America
Forest diseases: research and technical transfer services
Effects of ice-nucleating agents on canker, dieback, and mortality of juvenile forest trees and amenity species

---

Project leader:	**Professionals:**	**Technicians:**
Dr. H.F. Cerezke	P.A. Amirault	F.J. Emond
	Dr. Y. Hiratsuka	H.S. Gates
	Dr. H.R. Wong	P.J. Maruyama
	Dr. W.J.A. Volney	G.N. Still
	H. Zalasky	D.L. Szlabey
	(Retired April 1986)	R.C. Tidsbury

NOR-28

Wetlands and forest productivity modeling

Objectives: To determine the ecology of peatland development within the region; to develop guidelines for peatland management and rehabilitation; to improve the yields of forests through the drainage of waterlogged forest soils; to evaluate the effects of drainage on the hydrology of drained and undrained wetlands; to assess impact of climate on forest vegetation and soils, especially those associated with forest clear-cut areas; to determine the extent and degree of past short- and long-term climate fluctuations and the interrelationship between key parameters and measures of forest biomass productivity in selected regions of the boreal forest; to synthesize the available biomass data for the regionally important tree species for predicting biomass; to develop and test regional biomass equations for converting a conventional forest inventory to a biomass inventory; to investigate the impact of biomass removal on site quality, nutrient status, silvicultural options, and long-term site productivity on selected sites in the prairie provinces.

Achievements: Field studies on the ecology of wetland development have been concluded. A total of 252 wetlands have been studied in detail in Alberta, Saskatchewan, and Manitoba. Approximately 6000 peat samples were collected and analyzed for chemical and botanical composition. More than 1000 vascular plants, bryophytes, and lichens were collected and identified. Several journal papers and symposium contributions have been published. In cooperation with the Alberta Forest Service, three wetland sites in Alberta's boreal forest were selected, surveyed, and sampled as experimental drainage areas. Ditch plans were prepared for each, and ditch networks were marked in the field.

A new study was initiated to predict the risk of productivity losses from fire, insects, or diseases during the life of stands and entire forests. Initially the data from the Hinton forest are to be used for the study, which will later be expanded to include data from the boreal forests of Alberta and possibly Saskatchewan and Manitoba.

In connection with the ENFOR (ENergy from the FORest) program, 20 contracts were let to various consulting firms, progress was supervised, and the resulting reports were published. The topics included biomass volume and yield tables, growth models for various species, fuel characteristics of various species, innovative harvesting methods for forest biomass, and tree ring analyses. A number of Information Reports and journal articles were published.

Several publications have been finalized on the effect of clear-cutting on climate and the effect of climate on seedling growth related to stand edge. The effect of climate variations on tree growth was studied by tree-ring analysis, and reports were published.

1987–88 objectives: To produce reports on the ecology of wetland development in the Western and Northern Region; to construct drainage ditch systems on two of the three experimental areas and to monitor changes resulting from these treatments; to develop a risk factor analysis for predicting losses from fire, insects, or diseases, initially at a local level; to oversee the conclusion of ENFOR contract studies and adapt ENFOR reports for publication.

Studies:

Peatland development and ecology
Increasing wood production through forest land drainage
Boreal forest risk factor modeling
Impact of climate variation on boreal forest biomass
Development of integrated biomass prediction equations for the Western and Northern Region
An assessment of the energy potential of forest biomass in the prairie provinces and Northwest Territories

---

Project leader:	**Professionals:**	**Technicians:**
S.C. Zoltai	Dr. G.R. Hillman	M.W. Ali
	J.D. Johnson	E.B. Robson
	Dr. T. Singh	N.B. Schultz
		(Retired June 1986)

Forest Resources Research

NOR-4

Stand productivity and forest inventory

Objectives: To develop and assess silvicultural treatments and options for increasing the yields of managed stands and to evaluate them in economic terms; to provide forest management agencies with improved techniques and models for growth and yield prediction for the commercially important cover types of natural stands and managed stands that have received different silvicultural treatments and are growing on different sites in the prairie provinces and Northwest Territories; to evaluate, develop, and apply new remote sensing and interpretation techniques for forest inventories and environmental management purposes; to provide technology transfer and advisory services.

Achievements: Numerous long-term studies have been initiated in the past to obtain information on growth and yield of natural stands and on growth and yield following intensive silvicultural treatments. Such studies were also set up to develop guidelines and prescriptions for treatments such as spacing, thinning, and fertilization of lodgepole pine, jack pine, white spruce, and trembling aspen in the region. Results are published as they become available. Intensive short-term studies on tree and stand growth are also conducted to provide information and solutions for specific problems.

An experimental geographic information system (GIS) was developed to produce digital forest inventory map data bases and to convert these to a biomass inventory and maps; a computerized large-scale photo sampling and interpretation system has been designed, developed, and tested, and the computer camera control system is now being marketed by a private company; manual digital image analysis interpretation techniques for satellite and airborne imagery have been developed and applied in cooperation with provincial agencies and under the ENFOR (ENergy from the FORest) and Environment 2000 programs.

In 1986–87, one of the highlights of growth and yield technology transfer was a stand tending workshop held in southeast Manitoba. This workshop emphasized guidelines for thinning jack pine based on long-term CFS data. The workshop's technical seminar highlighted the use of STEMS (Stand and Tree Evaluation and Modeling System) for evaluating the outcome of different thinning alternatives in terms of final yield.

Other technology transfer activity included participation in the organization of an international symposium on managed stand culture in the northwestern United States, B.C. interior, and Alberta foothills regions. Two coauthored papers were prepared, one presenting strategies for reducing impacts from terminal shoot insects and the other presenting impact and reduction strategies for foliage and stem diseases and abiotic injuries. Results of a lodgepole pine fertilization study at Hinton, Alberta, a report on the effect of seismic line cutting in forest stands on tree growth and impact on harvest yield, and an analysis of the effect of logging practices on subsequent development of aspen stands in Saskatchewan were published.

During 1986–87, a new thrust was initiated to develop managed stand growth and yield forecasting models for lodgepole pine and white spruce in the region by pooling all available information. This program is supported by the Canada-Alberta Forest Resource Development Agreement. On a smaller scale, a similar program has been initiated under the Canada-Saskatchewan Forest Resource Development Agreement to improve growth and yield predictions in natural stands.

Over the past year, a leadership role has been taken on with the regional Growth and Yield Cooperative. Research in this field, especially as it relates to the improvement of yield prediction both for old growth and second growth (managed) stands, has high priority across the country. The co-op works toward pooling resources, data, and expertise and toward defining priorities and goals for research and development work.

A study in stand tending techniques in the mixedwood forest is progressing well. A draft report was prepared on growth response of white spruce to release from trembling aspen competition in spruce-aspen mixedwood forests based on data from Saskatchewan and Manitoba. Additional data is being collected in Alberta from a study established in 1951 to support this analysis. A contract report was completed that reviewed available information and presented preliminary guidelines on releasing white spruce from trembling aspen overstories.

In the area of forest inventory, reports on geographic information systems and the Procom-2 mapping technique for monitoring forest depletion were published. Activities in remote sensing included the delivery of an operational 70-mm aerial camera system to the Yukon government, completion of an accompanying operations manual, and delivery of a 5-day training course; a joint paper with cooperators on large-scale black and white and color aerial photographs for the measurement of tree crown areas was presented at a symposium; a large-scale photo project for regeneration asessments has been initiated under the Canada-Saskatchewan Forest Resource Development Agreement. Progress has been made on a cooperative project with the Petawawa National Forestry Institute on forestry image enhancements from high resolution MEIS II data to facilitate species discrimination and cover type mapping in mixedwood boreal forests.

1987–88 objectives: To conduct research, development, and technology transfer activities in growth and yield, intensive cultural treatments, and in remote sensing and interpretation. To provide technical input and leadership in the regional Growth and Yield Cooperative; to publish an updated bibliography of lodgepole pine; to remeasure jack pine spacing trials in Manitoba and write a Forest Management Note; to complete analysis and publish a report on white spruce tree and stand growth after release from aspen, and to assess growth and yield of white spruce-trembling aspen stands in relation to species mix and other variables; to publish two papers prepared for a stand culture symposium, one on reducing damage from leader damaging insects and one on reducing damage from stem diseases; to publish journal papers on red belt impact on lodgepole pine and on western gall rust dynamics and impact; to publish a report on economic returns from fertilizing 70- and 30-year-old lodgepole pine; to publish a report on the economics of spacing dense lodgepole pine; to write a paper on Lansat Thematic Mapper imagery spectral land combinations for interpretations and mapping; to analyze, using the Procom-2 and HP digitizer, data on cutovers obtained from

satellite imagery, and to publish results of such analyses; to cooperate with other federal and provincial agencies on a pilot remote sensing test for forest inventory updates and in an evaluation of aerial synthetic aperture radar imagery for forestry purposes; to prepare journal papers on stem diameter estimation from large-scale photos in mixedwood boreal forests, forest classification from satellite imagery, and describing a computer-based camera control system; to adapt a new computer-based light meter for low altitude applications; to complete the Canada-Saskatchewan forestry agreement project on regeneration assessment from large-scale photographs; to continue methodology developments for digital image enhancements with high resolution MEIS II data for forestry.

Studies:

Analysis of growth and yield of important tree species in the prairie provinces
Data-base development for growth and yield of important forest types in the prairie provinces
Transformation and movement of applied fertilizer elements (N, P, and S) in selected lodgepole pine stands
Fertilization and thinning of semimature lodgepole pine stands
Forest interpretation and mapping
Development and application of large-scale photo and image analysis techniques to forest inventories
Economic evaluation of intensive forest management practices
Stand tending techniques in the mixedwood forest section

Project leader:
Dr. I.E. Bella

Professionals:
Dr. J. Baker
C. Cieszewski
(From Sept. 1986)
H.S. Grewal
R.J. Hall
W.C. Moore
W.J. Ondro
Dr. R.C. Yang

Technicians:
S.J. Lux
T.J. Walsh
(Resigned Jan. 1987)
D. Coish

NOR-10

Regeneration and plantation management

Objectives: To promote the development and dissemination of silvicultural knowledge and its application, particularly in the area of forest regeneration and plantation management, by a) maintaining effective consultation and liaison with resource managers and other researchers regionally and across Canada, b) undertaking silviculture research and development, particularly in the areas of ecological site classification and site productivity, effects of mechanical site treatment on soil properties and seeding and planting chance and subsequent plantation development, field performance of stock and guidelines for their use, causes of early mortality in young softwood plantations, and effects and costs of various vegetation management techniques aimed at improving establishment and growth of new forest crops, and c) publishing scientific and technical reports on research and development undertaken. To prepare, negotiate, and supervise research contracts as required. To provide coordination between this and other NoFC projects and also national projects as appropriate.

Achievements: During 1986, there were no major changes in emphasis in the project. Research and technology transfer continued in the area of regeneration silviculture (including mechanization), vegetation management, forest ecology and site productivity, causes of early mortality in pine plantations, and site classification.

Regeneration silviculture work included continuation of a comprehensive 8-year planting stock performance trial for white spruce and lodgepole pine near Grande Prairie, Alberta. Seven-year results are now available, and all measurements will be completed in 1987. Work in Manitoba included preparation of reports on a variety of previously established CFS projects in the areas of fertilization, container and bare-root stock performance, and seeding, planting, and site treatment methods to achieve mixedwood site conversion to conifers. Technology transfer in silviculture continued through coordination of the Regional Reforestation Technical Committee (RRTC), an update of the national silviculture statistics report, and involvement in public awareness displays and workshops throughout the region.

Silviculture mechanization in 1986 focused mainly on a regionwide demonstration of disc trencher technology under the federal-provincial forestry agreements.

Vegetation management research and development included coordination of the initial treatments and assessment of a major project at Grande Prairie under the Canada-Alberta Forest Resource Development Agreement. There was ongoing consultation or liaison with vegetation management activities in Saskatchewan and Manitoba with CFS district staff. Vegetation management research and development is multidisciplinary, involving cooperation with forest industries and the provincial forest management agencies in Alberta, Saskatchewan,

and Manitoba. A summary document of past CFS herbicide research and development in Alberta and Manitoba was completed, and plans were made to continue related regional projects. A new Forestry Officer was hired for vegetation management research and development at NoFC.

The 1986 highlight in forest ecology and site productivity was publication of a field guide entitled *Forest ecosystems of west-central Alberta*, which applies principles of ecological classification to establish a framework to assist forest managers in decision making, including development of silvicultural prescriptions. There was technology transfer activity through the organization of the IUFRO (International Union of Forest Research Organizations) Northern Silviculture meeting in Grande Prairie, Alberta, and Dawson Creek, B.C. Also, a workshop was held and a paper presented on the subjects of soil compaction, the use of site classification criteria to assess forest productivity, and the application of the forest ecosystem field guide. Workshops for provincial forest management agency staff and forest industry personnel are planned to promote the use of this field guide.

Site classification activities also included the organization and chairmanship of a national CFS Committee on Site Classification and Land Evaluation (SCALE); proceedings of the meeting including recommendations for future action have been published. In addition, plans were made to conduct a cooperative site classification pilot study in Saskatchewan.

Assessment of the effects of climatic factors, insects, disease, and rodents upon survival and growth of pines up to 35 years of age continued with fourth and fifth year data collection for jack pine and lodgepole pine, respectively. Work on the Information Report entitled *A pictorial guide to the forest and shade tree insects of the prairie provinces*, continued and should be completed in 1987.

1987–88 objectives: To maintain regional research, development, and technology transfer activities in the demonstration and evaluation of silvicultural equipment, vegetation management, seedling field performance, forest site classification and land evaluation, site productivity, and cumulative mortality studies in pine; to develop contracts and act as scientific authorities for contracts under the federal-provincial forestry agreements, including vegetation management, site classification, and evaluation and forest management demonstrations. To cooperate with regional and national groups such as the Regional Reforestation Technical Committee, CFS Weed Management Working Group, Expert Committee on Weeds, CFS Mechanization of Silviculture Project, Silviculture Subcommittee of the Forest Engineering Research Institute of Canada, Forest Pest Management Institute, and the Canadian Forest Resource Data Program.

Studies:

Silvicultural investigations
Control of vegetation in managed forests
Forest ecology and site productivity
Evaluation of mortality in stands of young trees in plantations and scarified areas

Vegetation management techniques for forestry
Technology transfer in site classification and forest soils

Project leader:
L.G. Brace

Professionals:
Dr. I.G.W. Corns
W.D. Holland
W.G.H. Ives
M. Upton
(From Feb. 1986)

Technicians:
D.T. Allan
J.A. Drouin
(Retired May 1986)
J.R. Gorman
C.L. Rentz
P. Todd

NOR-12

Nursery management and tree improvement

Objectives: To formulate planning tools and guidelines for promoting improved standards for management of regional forest nurseries, particularly in the areas of bare-root and containerized seedling production, handling, storage, seed and seedling physiology, and cold tolerance; to produce genetically improved grafts, seed, seedlings, and rooted cuttings of jack pine in sufficient quantity to facilitate mass production by regional cooperators; to continually increase the degree of genetic improvement in jack pine and contribute knowledge on genetic variation in forest tree species; to use ecosystem models, where applicable, to assist regional clients in forest ecosystem management.

Achievements: Studies on cold hardiness and dormancy of lodgepole pine, jack pine, red pine, white spruce, and black spruce continued, in order to develop prescriptions for hardening seedlings in preparation for overwintering. Physiological testing of stock before, during, and after winter facilitated assessment of methods of monitoring seedling viability. Papers on this work were presented at the annual meeting of the Canadian Society of Plant Physiologists and at the 1986 Prairie Federal-Provincial Nurserymen's Meeting.

Studies on growth acceleration and early flowering in lodgepole pine, jack pine, and white spruce continued, and similar studies on black spruce were initiated. Light quality, photoperiod, and growth regulator (gibberellic acid) treatments have been applied, and flowering has been observed in lodgepole pine 2 years after outplanting in a nursery. A seminar on the influence of accelerated growth conditions on early growth and survival of lodgepole pine was given at the Department of Forest Science, University of Alberta, and a paper was presented at the annual meeting of the Canadian Society of Plant Physiologists.

A study designed to establish size class standards and develop methods of monitoring stock quality in Saskatchewan nurseries was continued, and a paper on this topic was presented at the 1986 Prairie Federal-Provincial Nurserymen's Meeting. Advisory, problem solving, and technology transfer services were provided to client nurseries throughout the region. Problem diagnosis concerning fertilization, acidification, peat application, and recommendations for solution were made. An important continuing service provided to provincial nurseries is the chemical analysis of soil and foliage and the interpretation of results that is done each winter. An invited paper on forest tree nursery operations in the prairie provinces was presented at the annual meeting of the Forest Nursery Association of British Columbia.

Two nutrient-related studies were completed. One was a study of the residual fertility in jack pine and white spruce seedbeds over a crop cycle, and the other was a study of the effect of nutrient regime on hardening of lodgepole pine, jack pine, white spruce, and black spruce. A

paper on nutrient regimes and cold hardiness was presented at the 1986 Prairie Federal-Provincial Nurserymen's Meeting.

Provenance tests of jack pine, red pine, Scots pine, white spruce, black spruce, and Norway spruce were evaluated, and only that of black spruce was recommended for further measurement. In the jack pine family test of the central breeding district, 40 families were selected based on height, diameter, and stem quality at 10 years. In the eastern breeding district, 15-year measurements of the jack pine family test were taken. Tree improvement technology was promoted in the region by designing a seed orchard layout for the Forestry Branch of the Saskatchewan Department of Parks, Recreation, and Culture, and on-site advice on tending grafts of superior jack pine clones at South Branch Nursery was provided. A plan for a research contract on rooting cuttings of white spruce, black spruce, and jack pine was prepared for the Forestry Branch of the Manitoba Department of Natural Resources. A paper was presented at a meeting of the IUFRO Working Group on Breeding Theory, Progeny Testing, and Seed Orchards in Williamsburg, Virginia.

Fieldwork related to the study of nutrient cycling in an aspen ecosystem was completed. Samples of precipitation, throughfall, leachate, and litter were chemically analyzed, and the results will be used in calibration of the FORCYTE growth simulation model. FORCYTE-10 and a preliminary version of FORCYTE-11 were installed on the NoFC VAX computer. Using a coprocessor, FORCYTE-11 was adapted to a microcomputer (IBM PC/AT), and a user-friendly superstructure program, PROBE, was developed to permit timesaving simulation runs. A FORCYTE seminar and workshop were held in Edmonton, and a preliminary list of input–output variables and a protocol for sensitivity testing of the model were developed. Papers on FORCYTE and PROBE were presented at meetings in Victoria and Richmond, B.C., respectively.

1987–88 objectives: To continue cold hardiness and dormancy tests and continue study of accelerated growth and early flowering in five conifer species; to investigate greenhouse and nursery problems and continue study on establishment of size class standards and monitoring stock quality; to prepare manuscripts on residual fertility in nursery seedbed and on fertilization for hardening off; to review forest nursery management and technology transfer needs in the region; to transfer documentation for terminated provenance tests; to plan an experiment to test genetic gain through mass selection and selection based on family test results; to provide functional guidance for development of jack pine seed orchards under the Canada-Manitoba Forest Renewal Agreement; to assist in sensitivity analysis of the FORCYTE-11 model and to plan and initiate its application to aspen and aspen-mixedwood management.

Studies:

Forest tree seed and seedling physiology
Provenance tests for coniferous species
Breeding jack pine for the northern region
Forest nursery research and technology transfer
NoFC greenhouse and nursery operations

Nursery soil fertility and seedling growth
Ecosystem and nutrient cycling modeling

Project leader:	Professionals:	Technicians:
Dr. I.K. Edwards	Dr. M.J. Apps	P.B. Chapman
	Dr. I.J. Dymock	F.M. Dendwick
	E.M. Harvey	W.M. Mills
	Dr. J.I. Klein	J.J. van Dyk

Forestry Extension and Planning

NOR-5

Fire management systems and guidelines

Objectives: To provide guidelines and standards to resource managers that will reduce, at an acceptable cost, the impacts of forest fires while considering the related economic, ecological, environmental, and social factors; to develop fire behavior guides for regional fuel types and incorporate them into the Canadian Forest Fire Danger Rating System (CFFDRS); to elucidate the natural role of fire and describe fire effects on forest ecosystems; to provide precise information on air tanker performance, fire retardant performance and effectiveness, retardant drop patterns, improved fire-line productivity, and fire detection systems and methodology; to develop, test, and promote the application of models simulating various suppression activities at the field operational level and directed toward improved utilization and effectiveness of funds, manpower, and equipment.

Achievements: Several papers and reports were prepared, including papers on foliar heat content, fuel moisture content, past prescribed burn evaluations, biomass regression equations, fire behavior, fire weather severity during the 1980 and 1981 fire seasons, fire danger rating, and prescribed fire. A prototype infrared/video fire spread analysis system was developed for future field trials. BASIC programs were developed for lap-top computers for calculating fire danger indexes. Project staff conducted a series of three additional successful experimental fires and related fieldwork in cooperation with the Alberta Forest Service at the Big Fish Lake study area in north-central Alberta.

Presentations on the fire research program were made at several meetings throughout the region. Numerous formal and informal meetings were held with provincial fire personnel in Alberta, Manitoba, and Saskatchewan regarding federal-provincial forestry agreement efforts. Two meetings of the CFS Fire Danger Group were attended, and all fuel consumption data were entered into the data base for the Canadian Forest Fire Behavior Prediction System. A prescribed fire working group was formed and the first meeting attended. Papers were presented at several national and international meetings, including the International Union of Forest Research Organizations (IUFRO) world congress in Ljubljana, Yugoslavia; the Western and Central Region Fire Weather Committee meetings and other sessions such as Fire Management Workshops; an advanced fire behavior course at Hinton, and meetings of the Kelsey Institute, Alberta Forest Service Rangers, and Alberta provincial parks management. Several meetings, seminars, and symposiums were sponsored, organized, cohosted, and chaired. A very successful regional fire research technical subcommittee meeting was also convened. A forest fire growth calculator was completed and distributed nationally, and a report entitled *Forest fire history maps of Alberta: 1931–1983*, was published.

A fireline productivity study was initiated with the University of Alberta under a Program of Research by Universities in Forestry (PRUF) contract.

1987–88 objectives: To conclude several additional papers on jack pine and fire for Alberta and Saskatchewan studies; to publish several papers based on thesis results on forest

fuels in Jasper National Park; to continue comparative evaluation of retardants and collect additional lightning fire origin data; to revise and finalize a regional fire research strategy and conduct an annual regional fire research technical subcommittee meeting; to publish the annotated bibliography of CFS fire research in the prairie provinces and NWT; to distribute a fire history atlas of Alberta; to continue the experimental burning in the Big Fish Lake area; to write a report on the Porter Lake experimental burning project; to determine the direction of the fire ecology study area; to develop expert systems on a local basis.

Studies:

Fire behavior in boreal forest fuels
Evaluation and development of fire detection-suppression technology
Evaluation of the role of fire in forest and intermingled vegetation in the prairie provinces, Rocky Mountains, and far north
Decision-aid models for use in fire management
Fire danger and behavior rating in forest and rangeland environments
Prescribed fire in forest and rangeland management
Northern Forestry Centre Forest Fire Research Coordination

Project leader:	**Professionals:**	**Technicians:**
Dr. R.J. Barney	M.E. Alexander	E. Kuyt
	Z. Chrosciewicz	M.E. Maffey
	G.P. Delisle	C.J. Ogilvie
	(Resigned Aug. 1986)	R.M. Smith
	B.S. Lee	
	R.S. McAlpine	
	W. Vanderschuit	
	(Resigned May 1986)	

NOR-13

Forest hydrology and microclimate research

Objectives: To provide forest management techniques to improve water yield from Alberta's Eastern Slopes forests; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on soil moisture and microclimate as they affect regeneration, establishment, production of fiber, and rotation duration; to evaluate the effects of events such as insect and disease damage, forest fires, and forest clearing activities on local water yield, regime, and quality.

Achievements: The results of clear-cutting studies at the Marmot (Cabin Creek) and Streeter Creek experimental basins have been published. Both treatments resulted in greater water yield, although the small clear-cuts at Streeter Basin are more in line with recommended practice to enhance water yield from either subalpine or foothills forests. All research at the Marmot experimental basin was terminated in October 1986, when the Alberta Cabinet rescinded Marmot's experimental status.

A field experiment on the influence of regeneration on wind speed and subsequent snow evaporation has been completed. The experiment was carried out in a 400-stem artificial forest of 2–3 m lodgepole pine at a site just north of NoFC, on the University of Alberta farm. Snow in clear-cuts provides protective cover for regeneration, soil moisture for early spring growth, and meltwater for downstream water users. A clear-cut with a smooth surface is thought to foster evaporation from the snow, thus limiting these benefits of snow cover. Analysis is expected to provide insights as to the effect of aerodynamic closure of regenerating lodgepole pine stands on wind speed and evaporation near the ground or snow surface.

1987–88 objectives: To continue to provide forest managers with practical management prescriptions and guidelines that will stabilize or improve the quantity, quality, and delivery time of water from forested areas; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on soil moisture and microclimate as they affect regeneration, establishment, production of fiber, and rotation duration; to carry out a problem analysis to ascertain the future of forest hydrological research in this region.

Studies:

Research coordination in the Alberta Watershed Research Program on Marmot, Streeter, Tri Creeks, and Spring Creek experimental basins
Vegetation manipulation—disposition of snow in forest clearings

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Project leader:
Dr. R.H. Swanson

Professionals:
Dr. P.Y. Bernier

Technicians:
Z. Fisera
P.A. Hurdle

NOR-53

Computing and data processing services

Objectives: To provide computing and computing-related services, office automation advice, telecommunications advice, financial system assistance, mapping and statistical service and assistance, computer education, networking, and computer capital coordination.

Achievements: The form of the services varies from writing computer programs for the VAX 11/750, HP1000, and a variety of personal computers to plotting on the laser printer, TEKTRONIX and NICOLET ZETA; providing data-base management systems; advising on the selection of computing equipment for individuals and data center use; providing statistical advice and program assistance; helping students during the summer who are working with other sections, and providing elementary and intermediate computer use and programming courses.

During the past year, VAX 11/750 usage has increased by 65%. Version 4.3 of the operating system was installed and is working, and 6 megabytes of memory have been installed, to bring the VAX up to three-quarter capacity. New versions of other software are also in place. The BMDP and SAS statistical packages are operational. The district offices have received letter-quality printers, terminals, and modems, and the Prince Albert office has a stand-alone DECMATE word processor (this will interact with the VAX as well for file transfers). Software has been installed to transfer files to and from the AES word processor and the VAX, and upgrades have been installed for the AES system and AM Varityper phototypesetter. A word processing package has been added to the VAX that will allow word processing on any VT100-type terminal and is compatible with the DECMATEs that have been assigned to the directors' secretaries. A noticeable increase in the number of users on the VAX has occurred since last year, and service bureau usage has dropped again. We have a computer terminal on at least each project leader's desk as part of the overall office automation strategy. Several courses were given to get new users on line. The new Olivetti personal computers have been installed for the financial system, which in turn will use new software being developed by CFS for use with the financial system and the VAX—there is one in each of the district offices and two at NoFC.

1987–88 objectives: To continue to supply and expand computing and data processing services to fill the needs of NoFC and the district offices; to assist with the DEVMIS programs for management of the federal-provincial forestry agreements; to provide services as required in all aspects of office automation, communications, computing equipment selection, computing education, and other computer-related fields.

Study:

Computing and data processing services

Project leader:	Professionals:	Technician
W. Chow	A.W. Irwin	L. Hai
	A.J. Paradis	
	G. Underschultz	
	(Term to Sept. 1986)	

Regional Development

NOR-3

Forest resource economics and statistics

Objectives: To provide socioeconomic information to regional forestry programs for rational policy formulation and program development by identifying and estimating the major economic benefits, product flows, and impacts of the forest resource and its utilization in the Western and Northern Region; to provide input to regional forestry programs by participating in interdisciplinary studies; to provide economic statistics and guidelines on costs and benefits of the forest resource, impacts of forest management, marketing, and related socioeconomic data; to collect and interpret forestry statistics at the regional and national levels in order to provide advice and guidelines to resource managers and researchers in support of forest policy decision making.

Achievements: A number of reports was published detailing progress made on projects under the Canada-Manitoba Forest Renewal Agreement. These involved studies on shearblading machine productivity and labor productivity for precommercial selection thinning. A compilation of forest economics and industry outlook material was assisted by the Canada-Alberta Forest Resource Development Agreement. Updated versions of the Saskatchewan and Manitoba directories of wood-using industries and a report on the role of forestry in the economy of the Northwest Territories were published. A paper was presented at the annual CIF meeting on silviculture decision making.

Various interdisciplinary research projects on economics of thinning, wildfire management, and vegetation management continued, and several presentations were made.

Work was initiated on the development and implementation of conversion software for Saskatchewan provincial inventories. Quality control checks were carried out on converted provincial data and aggregations for the three prairie provinces. Work continued on cataloguing and conversion of selected NoFC permanent sample plots (PSP) for inclusion in national PSP inventory. Data for over 2200 permanent sample plots across Alberta, Saskatchewan, and Manitoba will be included.

1987–88 objectives: To assist in the development and implementation of various interdisciplinary forest economic and silvicultural studies to provide operational guidelines for cost-effective use of funds in intensive and extensive forest management; to participate in evaluation programs in Manitoba, Alberta, and Saskatchewan; to participate in the studies of the National Forest Economics Program; to provide socioeconomic and statistical data, analysis, and documentation for policy and program development; to continue to provide input to the Canadian Forest Resource Data Program (national inventory and permanent sample plots); to prepare a landmark 10-year silviculture statistics Information Report; to develop a user's package for the PSP catalogue.

Studies:

Forestry resource economics and statistics research and coordination
Forestry and socioeconomic statistics and analysis/DEVMIS

Forestry development and fire management economics
Economic analyses of forest management practices
National Forest Economics Program—Silviculture investment analysis project

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Project leader:
D.M. Boylen

Professionals:
J.P. De Franceschi
D.H. Kuhnke
A.M. Mauch
(Resigned March 1987)
T.B. Williamson

Technician:
R.A. Bohning

NOR-36

Development agreements

Objectives: To implement federal-provincial forestry development agreements in Alberta, Saskatchewan, and Manitoba; to assess the impact of regional, national, and international economic and social events on regional development of the forestry sector; to assist the development and implementation of forestry-related job creation programs in the prairie provinces and Northwest Territories, and to assist in the development of other forestry-related federal initiatives, as required.

NOR-36-01

Canada-Manitoba Forest Renewal Agreement (Manitoba District Office)

Achievements: The Manitoba District Office has 17 staff members, with expertise in the areas of damage appraisal, silviculture operations and research, fire research, forest economics, and tree improvement. Manitoba District Office personnel are primarily involved in the Canada-Manitoba Forest Renewal Agreement, but they also carry out other activities, including extension and advisory services to industry and the public, job development program promotion and delivery, and public education. Public information activities included the production of numerous booklets and brochures of public interest, highlighting forestry activities in Manitoba.

Under the Canada-Manitoba Forest Renewal Agreement, Manitoba's two major forest companies, Abitibi-Price Ltd. and Manfor Ltd., carried out reforestation and intensive management activities, including site surveys, mechanical site preparation, seeding, and planting.

Capital expansion at provincial nurseries continued with the inauguration of greenhouses, a new cold storage and packing facility, and a tree improvement complex at Pineland Provincial Forest Nursery. At Clearwater Provincial Forest Nursery, new greenhouses and a seeding-line building were officially opened.

Insect and disease investigations addressed damage appraisal in jack pine budworm infested stands; over 105 permanent plots were established throughout the province. Data from this survey will be used to design an efficient damage appraisal survey program compatible with the forest inventory system in Manitoba. Also, a jack pine phenology study was initiated.

Fire research concentrated on the compilation and analysis of fire weather data and fire reports. The work included a survey and the evaluation of provincial fire weather stations, the instruction of provincial personnel in fire behavior prediction, and the use of the fire-weather-index program for personal computers. The past year also saw the completion of fuel-type maps for high-priority areas, and of a report on the use of bird-dog aircraft.

Interdisciplinary (economics and silviculture) studies of thinning and site preparation were done to establish guidelines for cost-effective intensive forest management. Our forest economists completed a detailed study of the province's forest industry and published a directory of primary wood-using industries. In addition, the interim evaluation of the agreement was completed.

Three workshops were held during 1986-87: a regional geographic information systems (GIS) workshop, a tree nursery management workshop, and a stand tending workshop.

1987–88 objectives: To manage and report on activities funded under the Canada-Manitoba Forest Renewal Agreement; to consult, liaise, review, monitor, and report on activities funded with federal funds under the cost-shared programs of the Canada-Manitoba Forest Renewal Agreement; to review the technical aspects of the federal forestry-related job creation programs.

Studies:

Forest pest management, surveys, and damage appraisal
Yields of managed stands: releasing white spruce from trembling aspen
Fire management
Regeneration: hare damage assessment and technology transfer
Establishment of jack pine seed orchards in Manitoba
Forest site classification
Forest nurseries
Forest economics
Forest inventory
Tree improvement
Silviculture research and technology transfer
Forest renewal and intensive forest management

NOR-36-02

Canada-Alberta Forest Resource Development Agreement and development program coordination (Northern Forestry Centre)

Achievements: Public information activities included the inauguration of a mobile trailer exhibit to promote forestry awareness and education; the publication of an accompanying four-color exhibit trailer brochure; the development of a five-panel exhibit for use at major exhibitions and meetings, and reporting on agreement-funded success stories and forest products research and development contracts.

Reforestation included work on both provincial Crown lands and on Indian reserves. In 1986–87, crews carried out reforestation surveys, stand establishment surveys, site preparation,

tree planting, stand maintenance, and the development of forest management plans for Indian bands.

Forest products research and development, carried out under contracts, concentrated on the development and testing of panelboards, the production of new wood products made with aspen poplar, and various market studies and technical seminars for the forest industry.

Forest research work included the continuation of a vegetation control pilot study, a wetland drainage study, an economic timber supply model for Alberta, the development of a permanent sample plot catalogue for the prairie region, and the establishment of a mountain pine beetle hazard rating system. Projects started in 1986–87 include the development of managed stand yield tables for lodgepole pine and the preparation of forest management demonstration sites.

A framework for the evaluation of the agreement was prepared.

1987–88 objectives: To review socioeconomic events—regionally, nationally, and internationally—and assess impacts in terms of the Canadian Forestry Service's mandate and programs in relation to regional development in the forestry sector; to develop, implement, and administer projects under various federal forestry-related job creation programs, as required; to commission an interim evaluation of the Canada-Alberta Forest Resource Development Agreement, and to coordinate federal economic development activities in the forestry sector with other federal government agencies, provinces, universities, forestry companies, and other interested groups. In addition, to establish program delivery capabilities necessary to ensure the successful development, funding, and implementation of projects pursuant to the following forestry agreement objectives within Alberta, Saskatchewan, and Manitoba: a) development and maintenance of timber supplies sufficient to ensure the long-term viability of the forest industry in the prairie provinces; b) efficient utilization of both softwood and hardwood forest resources; and c) economic development and diversification of provincial economies as well as improvement of employment and human resource development opportunities in the forestry sector.

Studies:

Forest vegetation management: silvicultural assessment of selected methods of site preparation and crop release in areas designated for softwood production in Alberta

Forest vegetation management: control of aspen development in areas designated for softwood production in Alberta

Forest vegetation management: environmental impacts and residue chemistry of forestry herbicides

Forest vegetation management: cost-effective strategies for vegetation management in areas designated for softwood production in Alberta

Tree improvement

Wetland drainage

Forest pest management and damage appraisal

Managed stand yield tables for lodgepole pine and white spruce

Forest economics, statistics, and timber supply modeling

Canada-Alberta public information subprogram
Demonstration project
Boreal risk factor modeling

NOR-36-03

Canada-Saskatchewan Forest Resource Development Agreement (Saskatchewan District Office)

Achievements: The 12 CFS personnel now located in Prince Albert have expertise in silviculture operations and research, forest protection (including fire and entomology), forest economics, forest mensuration, and growth and yield. Most of their activities are related to the Canada-Saskatchewan Forest Resource Development Agreement; however, district office personnel are also involved in job development program promotion and delivery, extension services to industrial clients, development and advisory services to the public, delivery of projects under the ENFOR (ENergy from the FORest) program, and public education.

Reforestation work was carried out with the forest industry, the province, Indian bands, and private woodlot owners. This included regeneration surveys, site preparation, and tree planting. In addition, forest management plans were drawn up. Comparative field trials of site preparation equipment were held.

Our silvicultural research work included the assessment of plantations, current planting, and planting stock production; an evaluation of the use of large-scale aerial photography for regeneration surveys, and measures to control residual poplars.

The CFS assisted the province with the acquisition of a geographic information system (GIS) and continued capital improvements at the Big River and Prince Albert forest nurseries.

Saskatchewan District Office personnel also conducted investigations in the following areas: forest economics, including a thorough review of Saskatchewan's primary wood-using industry and the initiation of an evaluation of the forest resource development agreement; fire research, emphasizing technology transfer through seminars, workshops, field trips, and a newsletter; and forest pest management, focusing on the current jack pine budworm infestation.

1987–88 objectives: To manage and report on activities funded under the Canada-Saskatchewan Forest Resource Development Agreement; to consult, liaise, review, monitor, and report on federally funded activities under cost-shared programs of the Canada-Saskatchewan Forest Resource Development Agreement; to consult, liaise, and advise other federal departments or agencies responsible for delivery of federal job development programs related to forestry; to deliver a program of forest mensuration research in Saskatchewan and to provide advisory services and technology transfer; to implement a program of silvicultural investigations through applied research, advisory services, technology transfer, field trials, reports, and surveys; to provide advice on vegetation management through technology transfer, liaison, and provision of advisory services; to provide a program of forestry public information

for the CFS, including media tours, ceremonies, feature articles, publications, news releases, and public relations; to carry out pest management and damage appraisal activities and provide advisory services through technology transfer.

Studies:

Forest mensuration research
Silviculture investigations
Forest nursery investigations
Fire management
Stem injection of residual aspen
Crop tree and vegetation response to various vegetation control treatments in boreal-mixedwood sites in Saskatchewan
Forestry public information
Insect and disease investigations
Forest economics

Project leader:	**Professionals:**	**Technician:**
H.S. Price	R.M. Coté	G. DeMeyer
	J. Mrklas	*(Resigned Jan. 1987)*

NOR-54

Management of regional development program

Objectives: To plan, implement, and manage a work program designed to meet the forestry development needs of governments, private industry, universities, and other agencies in the prairie provinces and Northwest Territories; to establish and maintain effective working relationships with resource management agencies in the region; to participate in the development of policy and program priorities at regional and national levels; to provide effective managerial, administrative, financial, and other services to the Regional Development Program.

Achievements: In 1982, NoFC assumed responsibility for the development and implementation of federal-provincial agreements in the prairie provinces. The Regional Development Program was established in late 1982.

Discussions and negotiations were initiated with officials of the Manitoba, Saskatchewan, and Alberta governments and resulted in the identification of proposed programs and funding levels for 5-year federal-provincial forestry agreements with these provinces. A $27 million Canada-Manitoba Forest Renewal Agreement was signed in March 1984, a $28 million Canada-Saskatchewan Forest Resource Development Agreement was signed in June 1984, and a $23 million Canada-Alberta Forest Resource Development Agreement was signed in October 1984.

In 1986–87, the emphasis of the agreements continued to be the capitalization of provincial nurseries, the acquisition and loading of geographic information systems, expansion of industrial forest renewal and intensive management programs, and operational research in the areas of tree improvement, site classification, forest products, growth modeling, and forest protection.

The economics group focused on the completion of industry directories, development of forestry perspectives for the prairie provinces, and interdisciplinary research into the economics of thinning, wildfire management, and vegetation management. Efforts also focused on the development of a permanent sample plot catalogue for the prairie provinces.

1987–88 objectives: To incorporate the agreements into federal-provincial delivery systems; to manage the portfolio under guidelines received from the Canadian Forestry Service's Development Branch, including the projects under the agreements that are functionally directed elsewhere; to continue the development and implementation of employment stimulation programs in the forest sector within existing constraints.

Study:
Program Director, Regional Development

Project leader:
Dr. M.J. Heit

Information

NOR-33

Information

Objectives: To coordinate and promote the planning and delivery of an effective information and technology transfer program in the Western and Northern Region; to provide relevant and timely information to a diverse audience including scientific, technical, forest industry, and business groups, and general public at a reasonable cost, using a variety of communications avenues (media, publications, personal contact, audio-visual presentations) and other available information; to provide scientific and technical editing and publishing services; to provide a full range of library and photographic support services to NoFC personnel and district offices.

Achievements: In 1986–87 an increased effort was put into public awareness and information activities. The public information season was initiated with the Edmonton Sportsman's Show and Sherwood Park Trade Fair. National Forest Week activities throughout the region and the major exhibition circuit attracted more than 90,000 visitors to our display booths. District office exhibits and public presentations were similarly increased during the year. NoFC staff also presented information exhibits at the Alberta Forest Products Association annual meeting, and the Alberta Science Teachers Council annual conference and assisted in many school tours of our research facilities.

In cooperation with the Alberta Forest Service, under the Canada-Alberta Forest Resource Development Agreement, a mobile trailer exhibit, *Alberta's Managed Forests*, was launched and operated throughout southwestern Alberta. It attracted just under 30,000 visitors during the summer 1986 operating season. An accompanying interpretive brochure was also produced.

More than 75 publications were produced in 1986-87 including 14 Information Reports, 11 Forest Management Notes, 1 Forestry Report, the 1985–86 Program Review, 31 journal or proceedings articles, and miscellaneous publications. The inaugural issue of a NoFC quarterly newsletter, *TimberLines*, was published. The NoFC information pamphlet, 16 Pest Leaflets, and various promotional items were either revised or developed. A new format for publication of technology transfer activities, the *Technology Transfer Note*, was developed. Project staff continued to respond to requests for publications and general forestry information. The continued services of a graphic artist (term) aided in the production of new exhibits and other published materials.

A retrospective evaluation of research applications was initiated preparatory to development of a planned approach to future technology transfer activities. A major workshop on geographic information systems was held in Winnipeg, Manitoba, with funding support from the three federal-provincial forestry agreements.

The library continued to provide a full range of services and initiated expansion to alleviate space and shelving limitations within the present facility. The photo section operated to full capacity with the addition of a term assistant and recently acquired photographic and processing equipment that will enhance production and service capabilities.

1987–88 objectives: To maintain the established levels of public information and technology transfer activities; to continue to implement communications subprogram activities under the three federal-provincial forestry agreements; to complete a retrospective evaluation of NoFC research and development applications; to assist staff in the preparation, publication, and distribution of scientific, technical, and public information; to provide a full range of library and photographic support services.

Studies:

Scientific and technical editing and publishing
Technology transfer and extension services
Public information and media relations
Library services

Project leader:
R.G. Newstead

Professionals:
A.C. Ascher
B. Boughton
D.J.S. Robinson
J.K. Samoil

Technicians:
D.J. Adams
J.H. Baker
P.S. Debnam
E.M. Hopp
D.D. Lee
S.S. Phillips
(Term to Nov. 1986)
H.M. Stewart

Management Services

NOR-51

Financial, administrative, and support services

Objectives: To provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide general administrative support services, including materiel management, records management, engineering, building maintenance, secretarial and office services, and vehicle fleet management.

Achievements: All support units continued to provide a high level of service to the two district offices in Prince Albert and Winnipeg and to the Centre.

1987–88 objectives: To continue to provide efficient administrative, materiel management, and financial support services.

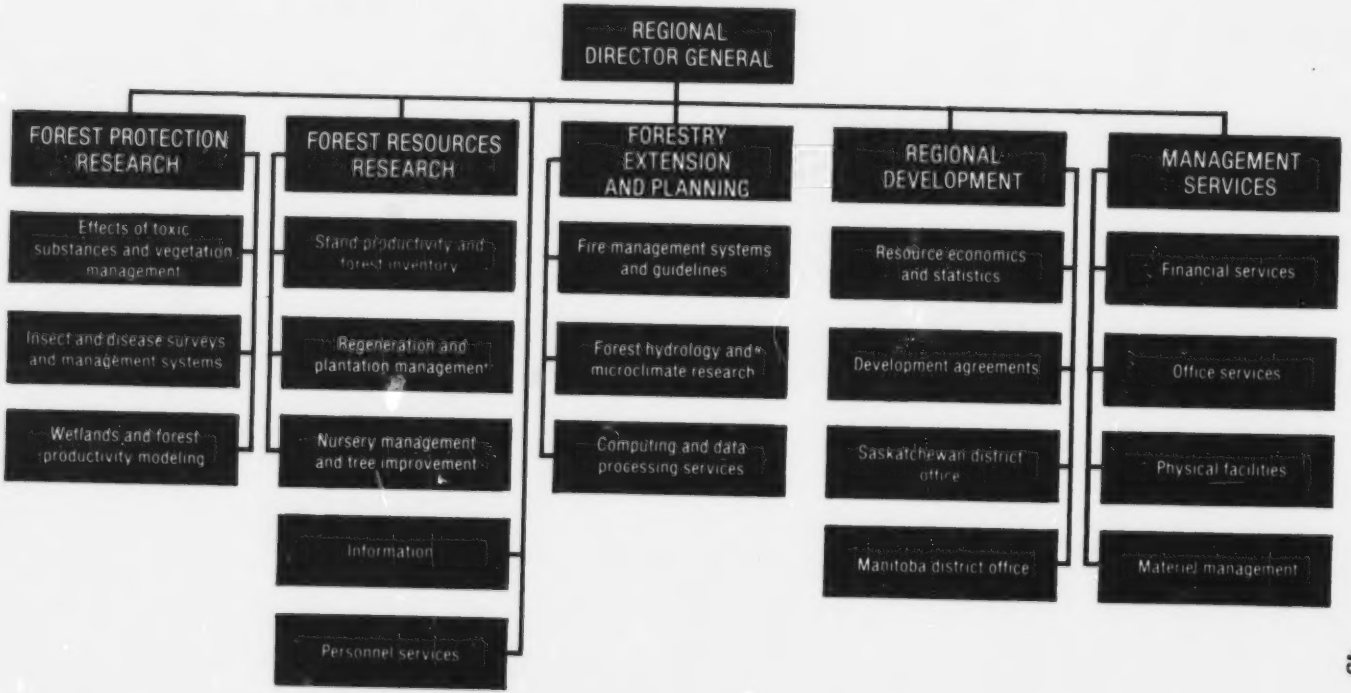
Studies:

Financial services
Administration
Office services
Materiel management
Physical facilities
Management services
Fleet management
Safety

APPENDIX A

NORTHERN FORESTRY CENTRE ORGANIZATION CHART

(As of March 31, 1987)



APPENDIX B

STAFF LISTING

(April 1, 1986, to March 31, 1987)

Regional Director General of Forestry: A.D. Kiil
Secretary—K.W. Conaty
(To Jan. 1987)
J. Palmer
(From Feb. 1987)

Program Directors

Forest Protection Research: Dr. S.S. Malhotra
Secretary—K. Conaty
(To Jan. 1987)
J. Palmer
(From Feb. 1987)

Forest Resources Research: R.M. Waldron
Secretary—R.V. Bown

Forestry Extension and Planning: Dr. J.M. Powell
Secretary—R.V. Bown

Regional Development: Dr. M.J. Heit
Secretary—R.V. Bown

Regional Manager, Management Services: P.G. Stewart
Secretary—R.V. Bown

FOREST PROTECTION RESEARCH

Dr. S.S. MALHOTRA

Project	Title	Professional Staff	Technical Staff
NOR-7	Environmental effects of toxic substances and vegetation management	Dr. S.S. Sidhu *(Project leader)* J.C.Y. Feng Y.P. Kalra Dr. D.G. Maynard	M.D. Fairbarns C. Feng *(From June 1986)* L.J. Milward F.G. Radford J.I. Ridgway *(Retired May 1986)* J. Shuya

Project	Title	Professional Staff	Technical Staff
NOR-11	Forest insect and disease surveys and management systems	Dr. H.F. Cerezke *(Project leader)* P.A. Amirault Dr. Y. Hiratsuka Dr. H.R. Wong Dr. B.H. Moody Dr. W.J.A. Volney H. Zalasky *(Retired April 1986)*	F.J. Emond H.S. Gates P.J. Maruyama G.N. Still D.L. Szlabey R.C. Tidsbury
NOR-28	Wetlands and forest productivity modeling	S.C. Zoltai *(Project leader)* Dr. G.R. Hillman J.D. Johnson Dr. T. Singh	M.W. Ali E.B. Robson N.B. Schultz *(Retired June 1986)*

FOREST RESOURCES RESEARCH

R.M. WALDRON

NOR-4	Stand productivity and forest inventory	Dr. I.E. Bella *(Project leader)* Dr. J. Baker C. Cieszewski *(From Sept. 1986)* H.S. Grewal R.J. Hall W.C. Moore W.J. Ondro Dr. R.C. Yang	S.J. Lux T.J. Walsh *(Resigned Jan. 1987)* D. Coish
NOR-10	Regeneration and plantation management	L.G. Brace *(Project leader)* Dr. I.G.W. Corns W.D. Holland W.G.H. Ives M. Upton	D.T. Allan J.A. Drouin *(Retired May 1986)* J.R. Gorman C.L. Rentz P. Todd
NOR-12	Nursery management and tree improvement	Dr. I.K. Edwards *(Project leader)* Dr. M.J. Apps Dr. I.J. Dymock E.M. Harvey Dr. J.I. Klein	P.B. Chapman F.M. Dendwick W.M. Mills J.J. van Dyk

FORESTRY EXTENSION AND PLANNING

Dr. J.M. POWELL

Project	Title	Professional Staff	Technical Staff
NOR-5	Fire management systems and guidelines	Dr. R.J. Barney *(Project leader)* M.E. Alexander Z. Chrosciewicz G.P. Delisle *(Resigned Aug. 1986)* B.S. Lee R.S. McAlpine W. Vanderschuit *(Resigned May 1986)*	E. Kuyt M.E. Maffey C.J. Ogilvie R.M. Smith
NOR-13	Forest hydrology and microclimate research	Dr. R.H. Swanson *(Project leader)* Dr. P.Y. Bernier	Z. Fisera P.A. Hurdle
NOR-53	Computing and data processing services	W. Chow *(Project leader)* A.W. Irwin A.J. Paradis G. Underschultz *(Term to Sept. 1986)*	L. Hai

REGIONAL DEVELOPMENT

Dr. M.J. HEIT

NOR-3	Resource economics and statistics	D.M. Boylen *(Project leader)* J.P. De Franceschi D.H. Kuhnke A.M. Mauch *(Resigned March 1987)* T.B. Williamson	R.A. Bohning
NOR-36	Development agreements	H.S. Price *(Project leader)* R.M. Côté J. Mrklas	G. De Meyer *(Resigned Jan. 1987)*
NOR-54	Management of regional development program	Dr. M.J. Heit *(Project leader)*	

	Professional Staff	Technical Staff
Saskatchewan District Office (Prince Albert)	J.J. Farrell *(District manager to Jan. 1987)* R.A. Fautley *(District manager From Feb. 1987)* W.J. de Groot A.C. Gardner C.A. Lee M.E. Newman A. Shortreid *(From Nov. 1986)*	M.D. Adamson *(Resigned June 1986)* K.P. Bacon G.R. Barth J.H. Johnston D.M. Sidders P.E. Taylor S.F. Urquhart
Manitoba District Office (Winnipeg)	J.A. McQueen *(District manager)* W.J. Ball N. Cataldo *(From June 1986)* M. Daoust-Savoie *(From April 1986)* K.G. Hirsch T.W. Steele D.R. Witt *(Resigned June 1986)*	B. Beaton *(From Sept. 1986)* C.B. Brown *(Resigned Oct. 1986)* L. Davies *(From Sept. 1986)* J.R. Dyck M.G. Grandmaison V.S. Kolabinski V. Lebedeff *(Resigned Sept. 1986)* A. Nanka B.I. Schlawitz S.M. Sokol N.R. Walker

INFORMATION

A.D. KIIL

Project	Title	Professional Staff	Technical Staff
NOR-33	Information	R.G. Newstead *(Project leader)* A.C. Ascher B. Boughton D.J.S. Robinson J.K. Samoil	D.J. Adams J.H. Baker P.S. Debnam E.M. Hopp D.D. Lee S.S. Phillips *(Term to Nov. 1986)* H.M. Stewart

MANAGEMENT SERVICES

P.G. STEWART

Position	Staff
Head, financial services	F.F. Allen *(Resigned July 1986)* D. Benke *(From Aug. 1986)*
Finance officer	B.D. Weiss *(Retired May 1986)* R.G. Cooper *(From Nov. 1986)*
Finance clerks	K.L. Briscoe-Adams *(Resigned Oct. 1986)* M. East *(Resigned May 1986)* J.J. Iskra R. Owens *(From June 1986)* L.A. Ross
Purchasing officer	J.E. Hodgins
Purchasing clerk	T.Y. Avenell
Storesperson	G.R. Fawcett
Vehicle clerk	J.L. Wake
Supervisor, office services	D.M. Burke
Records office supervisor	A.R. Fulton
Records clerk	M.K. Sampson
Word processor operators	E. Schiewe J.M. Simunkovic
Stenographer	S. Ratansi
Receptionist-typist	T.B. Phillips
Head, physical facilities	H. Schoendube
Chief engineer	R.J. Fisher
Maintenance engineers	A. De Costa W.B. Lybbert
Senior maintenance craftsman	S.T. Colistro
Maintenance craftsman	G.K. Burton
Groundskeeper	G.M. Schmidt
Assistant Groundskeeper	R. Kasprick
Electronics technician	P. Bihuniak

PERSONNEL

(Agriculture Canada employees located at the Northern Forestry Centre)

Personnel advisor	R.P. Czuj
Pay and benefits clerk	B.M. Grauman
Personnel clerk	M.C. Grbavec

APPENDIX C

EXPENDITURES 1986-87

Program area	Person-years	Salaries ($000)	Operations & maintenance[a] ($000)	Capital ($000)	Contributions ($000)	Total ($000)
Directorate	5.8	316.0	112.8	1,351.3	—	1,780.1
Management services	22.6	707.1	574.1	—	—	1,281.2
Forest protection	26.4	1,256.9	158.2	—	—	1,415.1
Forest resources	27.6	1,211.2	129.3	—	—	1,340.5
Forestry extension and planning	28.5	1,097.2	299.1	—	—	1,396.3
Regional development	12.7	621.4	68.2	—	—	689.6
ENFOR[b]	—	—	234.3	—	—	234.3
Manitoba agreement	10.9	358.8	420.3	51.9	1,244.1	2,075.1
Saskatchewan agreement	9.5	311.8	637.4	2,315.3	1,300.3	4,564.8
Alberta agreement	5.7	151.5	1,895.2	146.8	736.3	2,929.8
Job creation	2.0	89.5	16.0	—	—	105.5
NOGAP[c]	—	—	48.0	—	—	48.0
PRUF[d]	—	—	115.4	—	—	115.4
Student employment program	—	117.0	—	—	—	117.0
Cost-shared agreements	—	—	—	—	—	—
Total	151.7	6,238.4	4,708.3	3,865.3	3,280.7	18,092.7

a Includes contracts; see Appendix D.
b ENergy from the FORest, funded by Energy, Mines, and Resources Canada.
c Northern Oil and Gas Action Program.
d Program of Research by Universities in Forestry.

APPENDIX D

CONTRACTS LET OR SUPERVISED AND EXPENDITURES IN 1986-87

Contractor	Title	Amount ($)	Scientific authority
Delisle, G.P. 335 Rabastraliere Est. St. Bruno, Quebec J3V 2A7	Assembly of Jasper Park fuels data	1,100	R.J. Barney
Dempster, W.R. & Associates 14011 - 101 Avenue Edmonton, Alberta T5N 0K2	Risk factor modeling for yield prediction in the boreal forests of Alberta	20,000	T. Singh
Farrington, P. 10662 - 65 Street Edmonton, Alberta T6A 2P2	Preparation of plant tissue and organic and mineral soil samples from the ARNEWS plots in British Columbia and the prairie regions	7,900	D.G. Maynard
Kennedy, K.A. 10007 - 107 Street Fort Saskatchewan, Alberta T8L 2H5	Report on the vegetation description from the biomonitoring network in the vicinity of the Ram River and Strachan sour gas processing plants	4,397	D.G. Maynard

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Northwestern Industries P.O. Box 9864 Edmonton International Airport Edmonton, Alberta T5J 2T2	Development of a large-scale photo camera system installation and maintenance manual (Yukon NAP/CFS)	(Funded by Yukon Government)	R.J. Hall
University of Alberta (Dr. W. Phillips) Department of Rural Economy Edmonton, Alberta T6G 2J9	Collection and analysis of data to determine economic indicators for spacing in lodgepole and jack pine; compilation of a publications list relating to economic returns from spacing of lodgepole pine and white spruce released from aspen competition	2,000	W. Ondro
	Canada-Alberta Forest Resource Development Agreement		
Alberta Pallet Company Box 610 Airdrie, Alberta T0M 0B0	Pallet deck development	9,760	R.M. Côté
Arbokem Inc. C.P. 187 Beaconfield, Quebec H9W 5T7	A study of pulping and papermaking properties of aspen	20,000	J. Mrklas
Carrigan, D. 320, 10045 - 83 Avenue Edmonton, Alberta T6E 3C5	Remeasure the Hinton spacing experiment and calculate western gall rust infestation rates on lodgepole pine	2,030	I.E. Bella

Forintek Canada Corp. 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	Application of scanning and imaging technologies to assess decay and wood quality in logs and standing timber	29,311	R.M. Côté
Forintek Canada Corp. 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	Refinement of light-colored, fast curing phenol formaldehyde powdered adhesives suitable for industrial applications in the manufacture of waferboard and oriented strandboard	141,911	R.M. Côté
Forintek Canada Corp. 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	An assessment of applications and markets for lignin from steam pretreated aspenwood with emphasis on enhanced oil recovery	33,777	R.M. Côté
Forintek Canada Corp. 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	Potential for enzymatic lignin-based adhesive: state of the art review	40,017	R.M. Côté
Hayward, R. 8 Vardana Place N.W. Calgary, Alberta T3A 0C5	Establishment of forestry field plots and collection of vegetation and soil samples	9,800	S.S. Sidhu
Jager Industries Inc. 8835 MacLeod Trail S.W. Calgary, Alberta T2H 0M3	Engineering properties of oriented strandboard	104,854	R.M. Côté

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Johnson Forestry Services 419 Parkvalley Drive S.E. Calgary, Alberta T2J 4V3	To review in detail the scientific records held at the Northern Forestry Centre	14,565	R. Waldron
Konowalyk, L. 11040 - 83 Avenue Edmonton, Alberta T6G 0T7	Establishment of field plots and completion of pretreatment silvicultural assessment records	10,034	L.G. Brace
Research and Production Council P.O. Box 6000 Fredericton, N.B. E3B 5H1	Development of a consistent trap-bait and trapping system for jack pine budworm	6,000	B.H. Moody
Schmidt, R. 205, 550 Millbourne Road E. Edmonton, Alberta T6K 3N4	Establishment of field plots and completion of pretreatment silvicultural assessment records	11,075	L.G. Brace
Silvacom Ltd. 9868 - 33 Avenue Edmonton, Alberta T6N 1C6	Canadian permanent sample plot catalogue	33,950	D. Kuhnke

Stewart, J. 11627 - 51 Avenue Edmonton, Alberta T6H 0M4	Establishment of field plots for collection and preparation of vegetation and soil samples for chemical analysis	8,067	S.S. Sidhu
Western Archrib Ltd. P.O. Box 5648 Edmonton, Alberta T6C 4G1	Westlam certification and recognition	33,658	R.M. Côté
	Canada-Saskatchewan Forest Resource Development Agreement		
Hakmet Ltd. 881 Hardwood Blvd. Box 248 Dorion, Quebec J7V 2J5	Delta trial	64,897	D.M. Sidders
Industrial Forestry Service 1595 - 5th Avenue Prince George, B.C. V2L 3L9	Review of planting stock handling procedures in common use in Saskatchewan, and planting standards and planting quality and assessment procedures employed by the Province of Saskatchewan	31,096	A.C. Gardner
Letourneau, J. 11524 - 102 Avenue Edmonton, Alberta T5K 0R1	A study of the impacts of forest pests and damage appraisal	11,870	B.H. Moody
Prairie Environmental Services Ltd. Box 414 Raymore, Saskatchewan S6V 2R3	Greenwater Lake Provincial Park	15,622	J.J. Farrell, A.M. Mauch

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Smith, T. 6812 - 97 Avenue Edmonton, Alberta T6B 1C7	A study of the impacts of forest pests and damage appraisal	12,800	B.H. Moody
Woodland Resource Services Ltd. 10735 - 180 Street Edmonton, Alberta T5S 1G6	Review of white spruce and jack pine seed collection, processing, storage, and utilization procedures used in Saskatchewan	37,973	A.C. Gardner
	Canada-Manitoba Forest Renewal Agreement		
Clark, J. R.R. 2, Site J Compartment 5 Nanaimo, B.C. V9R 5K2	Interim evaluation of the Canada-Manitoba Forest Renewal Agreement	8,000	J.A. McQueen
Synthen Resources Ltd. 386 Montrose Street Winnipeg, Manitoba R3M 3M8	Interim evaluation of the Canada-Manitoba Forest Renewal Agreement	19,250	J.A. McQueen

Wells, R.E. 10845 - 32A Avenue Edmonton, Alberta T6J 3B8	Development of a methodology and rationale for a forest management site classification system	55,840	I.G.W. Corns
	ENergy from the FORest (ENFOR)		
Fedorus, J. Box 241 Slave Lake, Alberta T0G 2A0	Collect water and litter samples near Kinuso, Alberta	5,637	I.K. Edwards
Forintek Canada Corp. 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	Wood density — a survey of important Canadian tree species	34,503	J.M. Powell
Hendricks, P. 205, 10310 - 122 Street Edmonton, Alberta T5N 1M2	Assessment of 2-year biomass productivity in aspen cutovers near Calling Lake and Slave Lake, Alberta	1,798	H.S. Grewal
Hershberger, A. General Delivery Calling Lake, Alberta T0G 0K0	Collection of water and litter samples	1,747	I.K. Edwards
Keryliuk, M. P.O. Box 951 Gibbons, Alberta T0A 1N0	Chemical preparation and analysis of water samples and plant material	15,460	I.K. Edwards

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Life Science Programming Ltd. 602, 5775 Toronto Road Vancouver, B.C. V6T 1X4	Planning, execution, and interpretation of FORCYTE gaming trials	17,500	M.J. Apps
Western Ecological Services 205, 3347 Oak Street Victoria, B.C. V8X 1R2	Adaptation of nutrient cycling data to the FORCYTE growth simulation model for aspen stands	75,541	I.K. Edwards
	Northern Oil and Gas Action Program		
Kershaw, L.J. 51163 Range Road 204 Sherwood Park, Alberta T8E 1E5	Vegetation studies of environmental effects of disturbances in the subarctic	5,000	S.C. Zoltai
University of Alberta (Dr. G.P. Kershaw) Department of Geography Edmonton, Alberta T6G 2J9	Studies of environmental effects of disturbance in the subarctic	39,143	S.C. Zoltai

Lakehead University (Prof. R.J. Day & F.W. Bell) Thunder Bay, Ontario P7B 5E1	Evaluate the utility of glyphosate herbicide for control of trembling aspen in white spruce plantations in the boreal mixedwood forest	17,150	W.J. Ball
University of Alberta (Dr. J.R. Spence) Department of Entomology Edmonton, Alberta T6G 2J9	Host effects on population dynamics and differentiation of the mountain pine beetle in southwestern Alberta	17,730	H.F. Cerezke
University of Alberta (Dr. P.J. Murphy, Dr. P.M. Woodward, & D. Quintilio) Faculty of Forestry Edmonton, Alberta T6G 2J9	Development of fireline production information for attack and sustained construction situations for several fuel types	31,070	R.J. Barney
University of Alberta (Dr. E.R. Reinhelt) Department of Geography Edmonton, Alberta T6G 2J9	Development of a climatology of atmospheric conditions related to extreme forest fire behavior in west-central and northern Canada	15,168	M.E. Alexander
University of Alberta (Dr. P.V. Blenis) Department of Plant Science Edmonton, Alberta T6G 2J9	Epidemiology of Armillaria root rot in Alberta	24,995	Y. Hiratsuka

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
University of Alberta (Dr. R.L. Rothwell) Department of Forest Sciences Edmonton, Alberta T6G 2J9	Testing and validation of the U.S. Forest Service's approach to water resource evaluation of nonpoint silvicultural sources (WRENSS)	5,099	R.H. Swanson
Total		1,109,095	

APPENDIX E

PUBLICATIONS 1986-87

(As of March 31, 1987)

Addison, P.A.; L'Hirondelle, S.J.; Maynard, D.G.; Malhotra, S.S.; Khan, A.A. 1986. Effects of oil sands processing emissions on the boreal forest. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-284.

Addison, P.A.; Khan, A.A.; Baker, J.; Malhotra, S.S.; Theriault, F.; Radford, F.; Ridgway, J.I. 1981. Effect of mixed pollutants on soil-plant microcosms. Alberta Environ., Res. Manage. Div., Edmonton, Alberta. RMD Rep. L-94.

Amirault, P.A.; Brown, N.R. 1986. Cone and seed insects of tamarack, *Larix laricina* (Du Roi) K. Koch, and attempts to control damage using chemical insecticides. Can. Entomol. 118:589-596.

Ascher, A., editor. 1986. Timberlines No. 1. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Ball, W.J.; Kolabinski, V.S. 1986. Performance of container and bare-root stock on prescribed burns in Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-283.

Bella, I.E. 1986a. Logging practices and subsequent development of aspen stands in east-central Saskatchewan. For. Chron. 62:81-83.

Bella, I.E. 1986b. Spacing effects 20 years after planting three conifers in Manitoba. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note 39.

Bella, I.E. 1986c. Tree growth response along seismic lines in Alberta. For. Chron. 62:29-34.

Bernier, P.Y. 1986a. Extrapolating snow measurements on the Marmot Creek experimental basin. Nordic Hydrol. 17:83-92.

Bernier, P.Y. 1986b. A programmed procedure for evaluating the effect of forest management on water yield. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note. 37.

Bernier, P.Y.; Swanson, R.H. 1986a. Snow measurements. Pages 3-6 *in* J.K. Samoil, editor. Hydrology. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Rep. 31.

Bernier, P.Y.; Swanson, R.H. 1986b. A watershed management pilot project in Alberta. Pages 87-92 *in* Proc. West. Snow Conf. Annu. Meet., April 15-17, 1986, Phoenix, Arizona. Colorado State University, Fort Collins, Colorado.

Bohning, R.A. 1986. The forest industry in the economy of the Northwest Territories, 1980-81. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-277.

Bohning, R.A. 1987. Tables and facts *in* J.K. Samoil, editor. Manitoba's forests. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Rep. 32.

Cerezke, H.F.; Holmes, R.E. 1986. Control studies with carbofuran on seed and cone insects of white spruce. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-280.

Chrosciewicz, Z. 1987. Evaluation of postburn seeding of jack pine in central Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note 41.

Chrosciewicz, Z. 1986a. Foliar heat content variations in four coniferous tree species of central Alberta. Can. J. For. Res. 16:152-157.

Chrosciewicz, Z. 1986b. Foliar moisture content variations in four coniferous tree species of central Alberta. Can. J. For. Res. 16:157-162.

Corns, I.G.W.; Annas, R.M. 1986a. Ecological classification of Alberta forests and its application in forest management. Pages 53-61 *in* G.M. Wickware and W.C. Stevens, cochairmen. Proc. Site. Classif. Relat. For. Manage. Symp., August 27-29, 1985. Canada-Ontario Joint For. Res. Comm., Symp. Proc. O-P-14.

* Corns, I.G.W.; Annas, R.M. 1986b. Field guide to forest ecosystems of west-central Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Delisle, G.P.; Hall, R.J. 1987. Forest fire history maps of Alberta, 1931 to 1983. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Denyer, W.B.G. 1987a. Urban home garden composting. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. M 1-75.

Denyer, W.B.G. 1987b. What's wrong with my tree? Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 4-75.

Drouin, J. 1987a. Pear slug. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 2-75.

Drouin, J. 1987b. Poplar bud gall mite. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 13-76.

Drouin, J. 1987c. Spruce budworm. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 20-77.

Drouin, J. 1987d. To spray or not to spray. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 6-75.

Drouin, J. 1987e. A willow shoot-boring sawfly. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest. Leafl. PL 24-78.

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* Publication funded in part by one or more of the federal-provincial forestry agreements.

Edwards, I.K. 1986. Review of literature on fertilization and conifer seed production. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note 40.

Emond, F.J.; Wong, H.R. 1987. Common insects attacking poplar stooling beds in the prairie provinces. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note 42.

Feng, J.C.; Klassen, H.D. 1986. Forestry field and laboratory manual for herbicide residue sampling, sample processing and reporting. Can. For. Serv., For. Pest Manage. Inst., Sault Ste. Marie, Ont. Inf. Rep. FPM-X-72.

* Giles, D.R.; Bohning, R.A. 1986. Directory of primary wood-using industries in Manitoba 1985. Can. For. Serv., Winnipeg, Manitoba, and Manit. Dep. Nat. Resour., For. Branch, Winnipeg, Manitoba.

Golding, D.L.; Swanson, R.H. 1986. Snow distribution patterns in clearings and adjacent forest. Water Resour. Res. 22(13):1931–1940.

Harvey, E.M. 1986. Introduction to session on the prairie nurseries. Pages 24–30 *in* J.W. Maxwell, editor. Proc. Can. For. tree nursery control workshop. B.C. Minist. For. Lands, Surrey, B.C.

Harvey, E.M., compiler. 1986. Proceedings of the 1984 Prairie Federal-Provincial Nurserymen's meeting. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-274.

Harvey, D.A.; Alexander, M.E.; Janz, B. 1986. A comparison of fire-weather severity in northern Alberta during the 1980 and 1981 fire seasons. For. Chron. 62:507–513.

Hildahl, V. 1987a. Fall cankerworm. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 3–75.

Hildahl, V. 1987b. Forest tent caterpillar. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest. Leafl. PL 17–77.

Hildahl, V. 1987c. Yellow-bellied sapsucker. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Pest Leafl. PL 7–75.

* Hiratsuka, Y. 1987. Forest tree diseases of the prairie provinces. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-286.

Hiratsuka, Y. 1986. Cytology of an autoecious soft pine blister rust (*Peridermium yamabense*) in Japan. Mycologia 78(4):637–640.

Kiil, A.D.; Quintilio, D.; Alexander, M.E. 1986. Adaptation of a national system of fire danger rating in Alberta, Canada: A case study in technology transfer. Pages 410–421 *in* Proc. 18th IUFRO World Congr. Div. 6. Gen. Subj. Int. Union For. Res. Org., Vienna, Austria.

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* Publication funded in part by one or more of the federal-provincial forestry agreements.

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